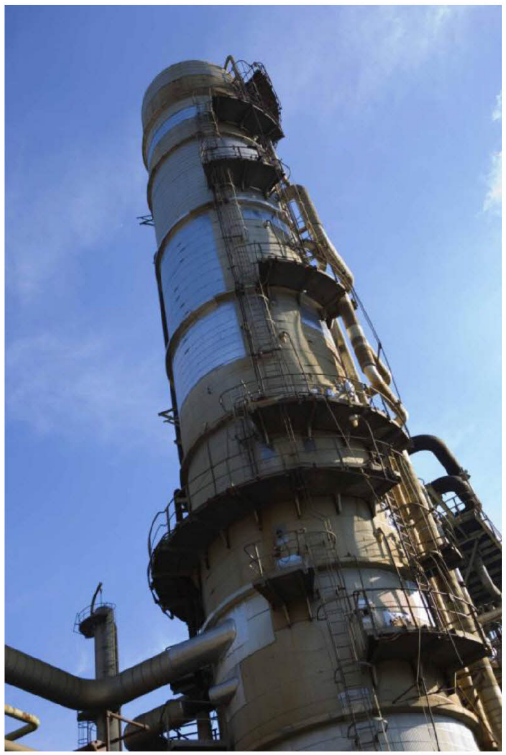
Chloride Stress Corrosion Cracking



Senior Analyst and Inspector Training
Crude Units

Chloride Stress Corrosion Cracking

Characteristics

- Affects only austenitic stainless steels — primarily 300 Series
- Occurs primarily at slightly elevated temperatures around 140-250°F (60-120°C)
  - Sensitized stainless can crack at ambient temperatures
- Dry chlorides do not cause cracking
- In crude units, the primary areas of concern are the column overhead systems, where chlorides are abundant
- For stainless equipment which usually runs hot and dry (e.g., furnace tubes and transfer lines), it's important to minimize chloride contact at downtimes because cracking can occur during startup
- Chloride cracks are tight, transgranular, and branchy

Chloride Stress Corrosion Cracking (Cont'd)

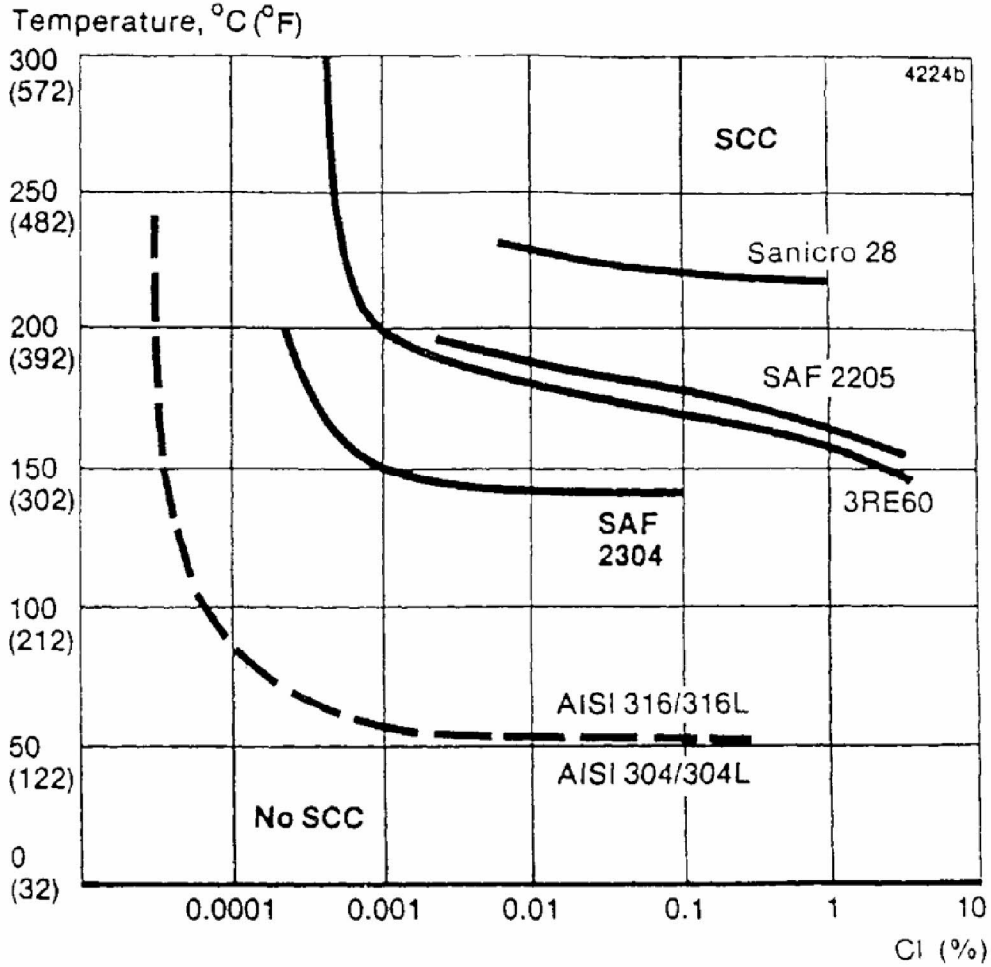
Prevention

- Avoid using 300 Series stainless in column overhead systems
- Stress relieve SS welds to lessen likelihood
- Limit hydrotest water to 50 ppm chlorides — thoroughly drain water and flush with wash oil before startup
- Keep insulation dry and use protective coatings (e.g., polysiloxanes or aluminum foil wrapping) to minimize the risks of external cracking
- Eliminate non-flow dead legs in SS piping, especially if they're cool enough to condense water

Inspection

- See Inspection Strategy IS-14 (API 571 #23)

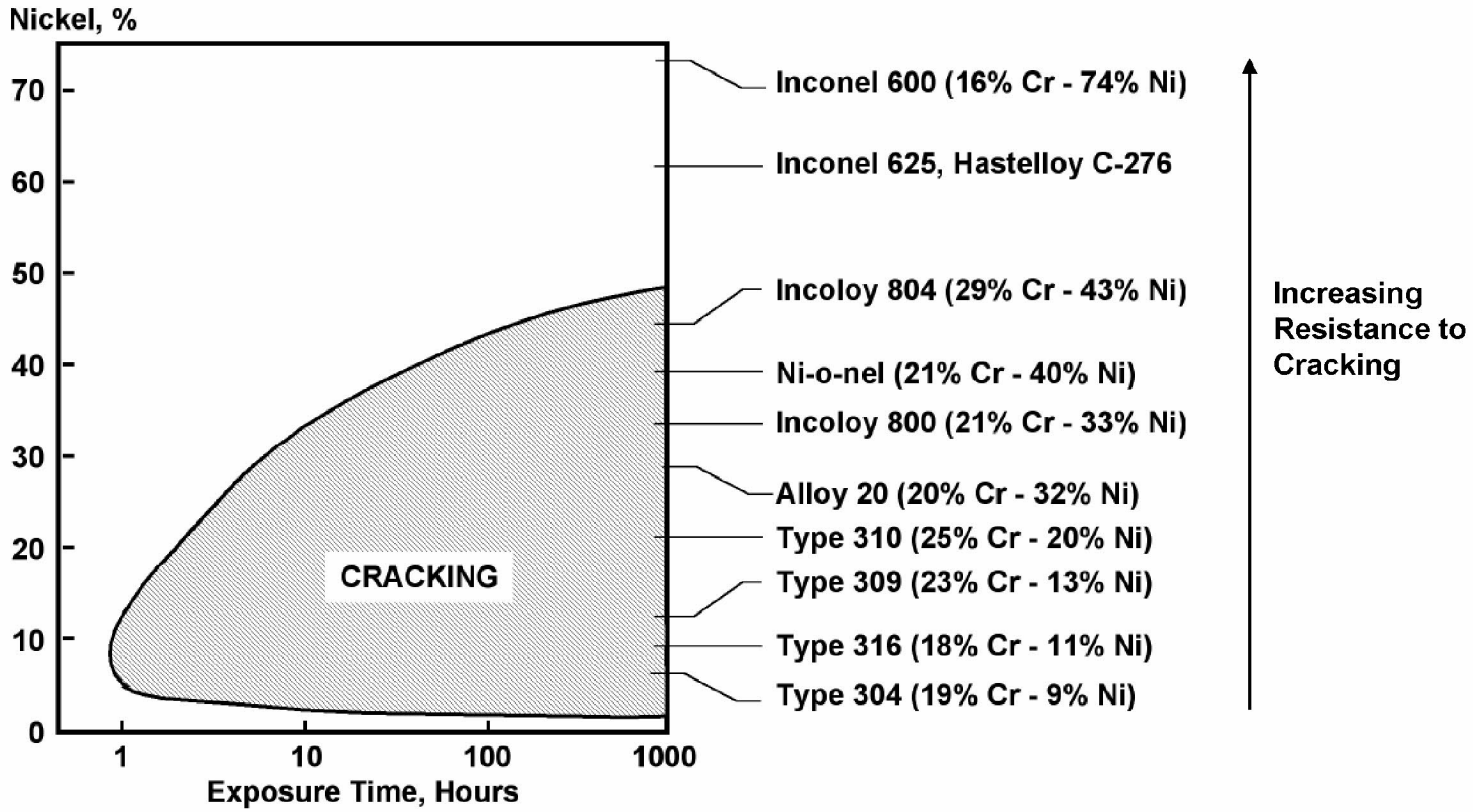
Test Data of Different Stainless Steels in Chloride Environments



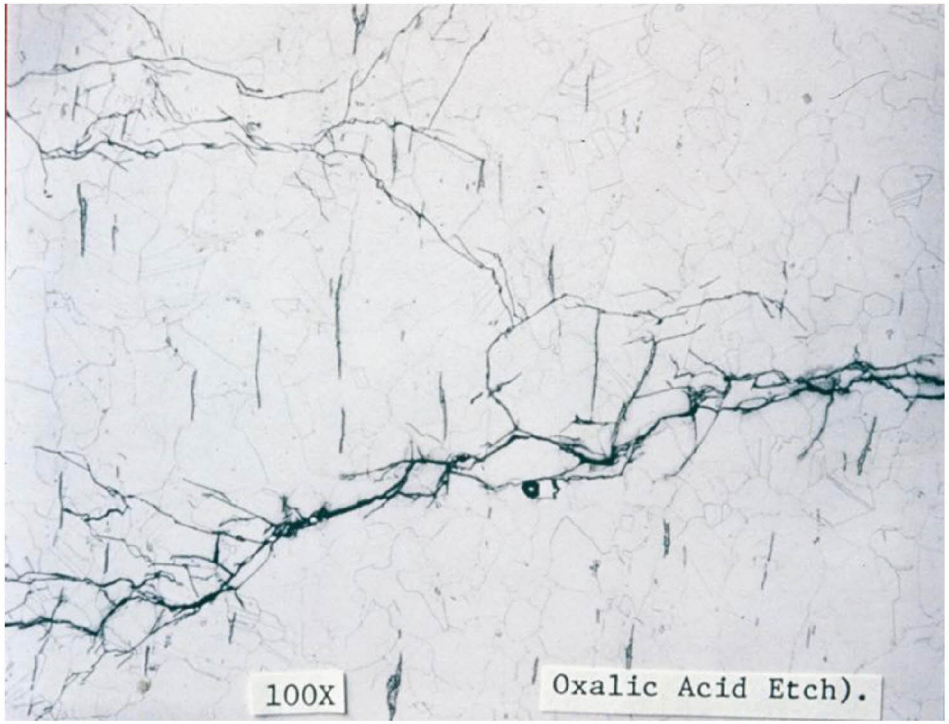
A Compilation of Practical Experience and Laboratory Test Data of Different Stainless Steels in Neutral Aerated Aqueous Chloride Environments

Effect of Nickel Content on Chloride Cracking Susceptibility of Cr-Ni Alloys in Boiling Magnesium Chloride

Several commercial alloys are shown below; resistance to cracking increases with nickel content



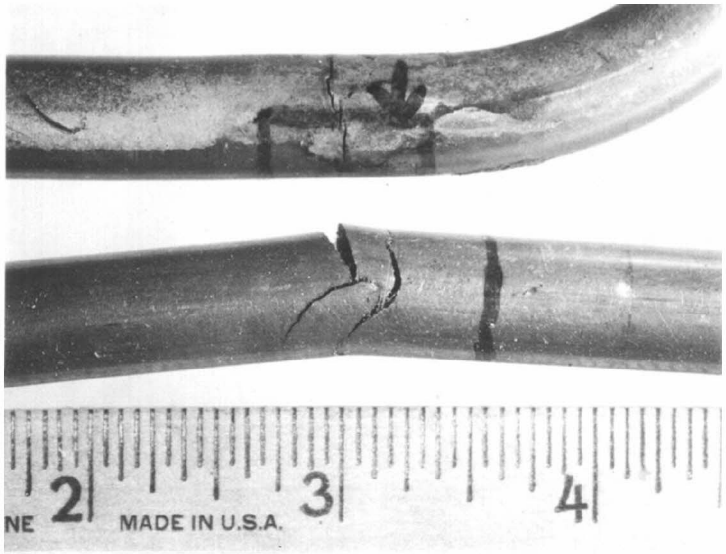
Appearance of Chloride Stress Corrosion Cracking



Transgranular and branched cracks, typical of chloride stress corrosion cracking in austenitic stainless steel

Chloride SCC of 304 SS Instrument Tubing at Pascagoula's Atmospheric Column Seventh Sidecut Reflux

Stress relief could help but using resistant alloys (e.g., Monel or Alloy 825) is best for prevention

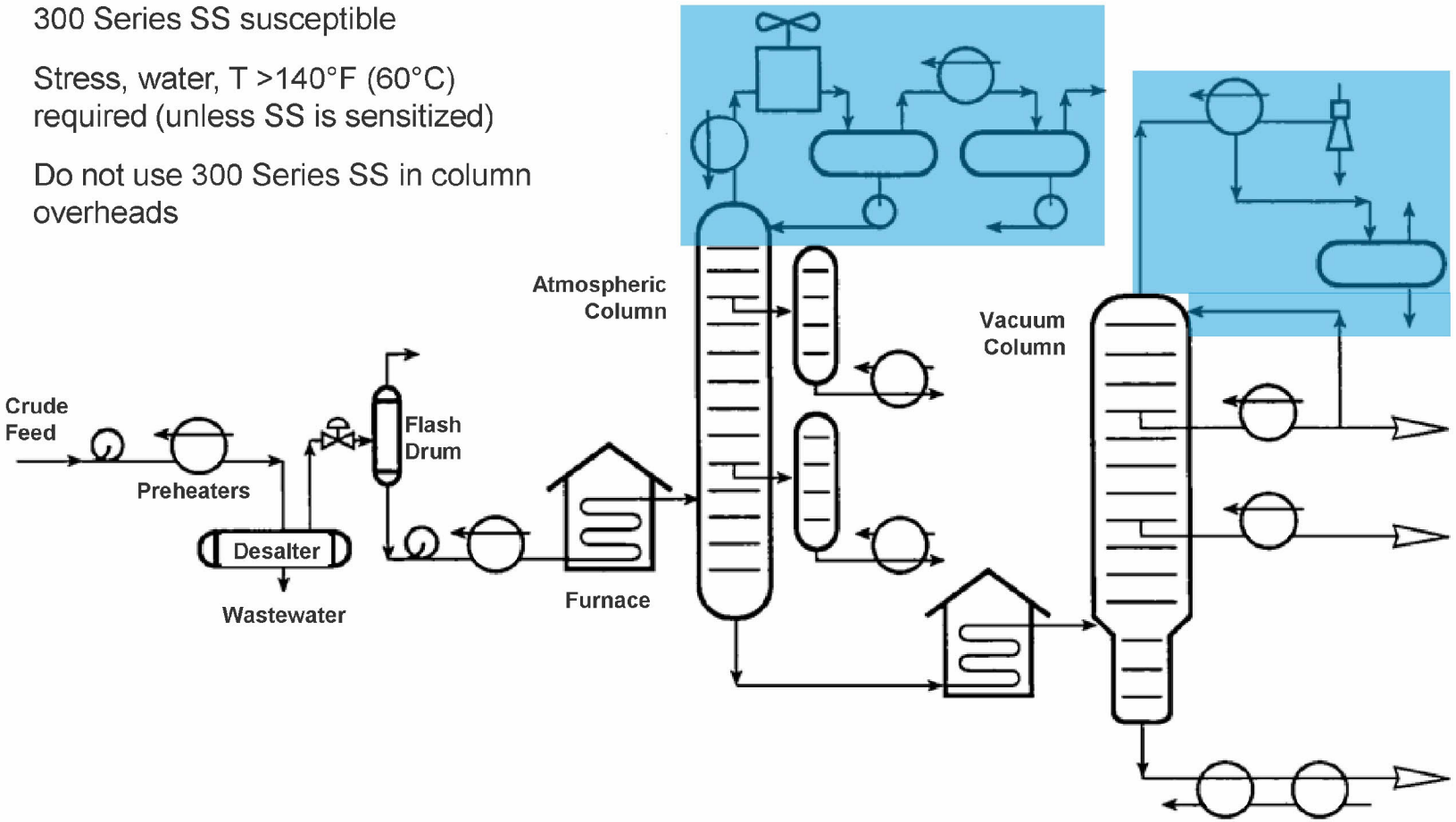


Cracks in 304 stainless tubing. Both straight and bent sections exhibit cracking.

Transgranular, branched cracks from the ID surface. Cracks are typical of chloride stress corrosion cracking.

Typical Areas in Crude Units Susceptible to Chloride Stress Corrosion Cracking

- 300 Series SS susceptible
- Stress, water, T >140°F (60°C) required (unless SS is sensitized)
- Do not use 300 Series SS in column overheads



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